

## **REMARKS**

The Applicants sincerely appreciate the Examiner's thorough examination of the present application as evidenced by the Office Action of November 2, 2005 ("the Office Action"). In response, the Applicants have amended Claim 1 to more clearly define the claimed invention; rewritten Claims 5, 7, 12, and 15 in independent form; canceled Claim 6; amended Claim 8 to depend from Claim 15; canceled Claims 13-14; amended Claims 20, 26, 27, and 33 to more clearly define the claimed invention; and added new Claims 68-94. The Applicants will also show in the following remarks that all pending claims are patentable over the cited art. Accordingly, the Applicants respectfully submit that all claims are in condition for allowance, and a Notice of Allowance is requested in due course.

### **Election Of Claims 1-33 Is Affirmed**

The Applicants affirm the election of Claims 1-33 as set forth in the Office Action. Accordingly, Claims 34-67 have been canceled.

### **All Double Patenting Rejections Have Been Overcome**

Claims 1-33 have been rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-55 of U.S. Patent No. 6,863,209. As noted in the Office Action, a timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome a rejection based on a nonstatutory double patenting ground provided that the conflicting patent is shown to be commonly owned with this application. A terminal disclaimer in compliance with 37 CFR 1.321 is being submitted concurrently herewith, thereby overcoming all double patenting rejections.

The Applicants note that a terminal disclaimer has been filed to advance prosecution of the present application without conceding the merits of the double patenting rejection.

### **The Subject Matter Of Claims 5, 12, 15-16, 18-19, And 28-29 Is Allowable**

The Applicants note that the only rejections applied to Claims 5, 12, 15-16, 18-19, and 28-29 are the double patenting rejections discussed above. As the double patenting rejections

have been overcome with the filing of the Terminal Disclaimer, the subject matter of these claims is allowable.

Independent Claims 18, 19, 28, and 29 are thus in condition for allowance because all outstanding rejections with respect to these claims have been overcome.

Dependent Claims 5, 12, and 15 have been rewritten in independent form (without unnecessary recitations). Accordingly, Claims 5, 12, and 15 are also in condition for allowance. Moreover, dependent Claims 16, 71-72, 75-82, and 91-94 are also in condition for allowance as depending from Claims 5, 12, 15, 18, 19, 28, and 29.

#### **Claims 26 And 33 Are Patentable Over Ecer**

Claims 26 and 33 have been rejected under 35 U.S.C. Sec. 102(b) as being anticipated by U.S. Patent No. 5,812,925 to Ecer (hereinafter "Ecer"). Claims 26 and 33, however, are patentable over Ecer for at least the reasons discussed below.

As amended, Claim 26 recites a method of bonding two components. The method of Claim 26 includes:

- positioning the two components relative to one another to obtain a desired orientation; and
- bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding;
  - wherein bonding comprises providing particles of the metal on the two components and bonding the metal particles;
  - wherein bonding the metal particles comprises applying pressure to the metal particles;
  - wherein at least one of the two components comprises a micro-electronic component, an optical component, and/or a micro-mechanical component.

As amended, Claim 33 recites a method of bonding two components. The method of Claim 33 includes:

- positioning the two components relative to one another to obtain a desired orientation; and
- bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding and wherein a temperature of the metal is maintained below a melting temperature of the metal while bonding;

wherein at least one of the two components comprises a micro-electronic component, an optical component, and/or a micro-mechanical component.

Accordingly, each of Claims 26 and 33 has been amended to clarify that at least one of the two components comprises a micro-electronic component, an optical component, and/or a micro-mechanical component.

In contrast, Ecer discusses "joining processes for aerospace and automotive components" (Ecer, col. 1, lines 33-34), and more particularly, a "rocket component" (Ecer, col. 4, lines 63). Ecer, however, fails to teach or suggest bonding two components wherein at least one of the two components comprises a micro-electronic component, an optical component, and/or a micro-mechanical component. Moreover, Ecer discusses typical bonding pressures that "range between 70 Mpa and 700 MPa" (*see*, Ecer, col. 4, lines 53-54), and these bonding pressures are incompatible for use with micro-electronic, optical, and/or micro-mechanical components as recited in Claims 26 and 33.

For at least the reasons discussed above, the Applicants respectfully submit that Claims 26 and 33 are patentable over Ecer. In addition, Dependent Claims 68 and 69 are patentable at least as per the patentability of Claims 26 and 33 from which they depend.

#### **Claim 1 Is Patentable Over The Combination Of Ecer, Avery, and Jung**

Claim 1 has been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over Ecer in view of U.S. Patent No. 6,340,113 to Avery et al. (hereinafter "Avery") and further in view of U.S. Patent No. 6,390,355 to Jung (hereinafter "Jung"). The Applicants respectfully submit that Claim 1 is patentable over the combination of Ecer, Avery, and Jung for at least the reasons discussed below.

As amended, Claim 1 recites a method of bonding two components. The method of Claim 1 includes:

positioning the two components relative to one another to obtain a desired orientation; and

after positioning the two components, bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding wherein bonding comprises plating the metal on the two positioned components.

The Office Action concedes that "Ecer does not expressly teach, bonding comprising plating the metal between the two positioned components...." (The Office Action, page 6.) In support of the rejection, the Office Action further states that:

However Avery et al. teaches a method of low temperature joining of electronic components wherein bonding comprises electroplating or electroless plating of the bimetallic particles on the two positioned components in order to produce a uniform coating. (see column 4, lines 16-53 and figure 3).

Ecer in view of Avery et al teaches all the elements of Claim 1....

The Office Action, page 6. The Office Action does not cite any portions of Jung as teaching or suggesting plating metal on two positioned components.

The Applicants respectfully submit that Avery fails to teach or suggest plating metal on two positioned components after positioning the two components. As discussed by Avery:

Various techniques ... can be used to form the coated, bimetallic particles of the invention, including for example, plating techniques.

Avery, col. 4, lines 28-30. In addition, Avery states that:

Tin-coated particles ... were prepared by coating lead in a standard commercial electroless tin plating solution. ... The particles had to be vigorously agitated while in the plating solution in order that each particle was uniformly coated and that they did not bond together. (Underline added.)

Avery, col. 9, line 66 to col. 10, line 15. Plating of Avery is used to form bimetallic particles in a standard plating solution, and agitation is used to provide that the particles do not bond together during plating. Moreover, as shown in Figures 3-5, the solder composition 10 is applied to the substrate 32 before electronic components 42 and 44 are connected to the solder composition/substrate 10/32. *See*, Avery, col. 8, lines 8-64. Accordingly, Avery fails to teach or suggest bonding comprising plating metal on two positioned components.

Avery also fails to teach or suggest bonding with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding. As discussed in Avery:

Upon joining and heating of the assembly, the metal contacts of the substrate 32 and components 42, 44 are joined by the partial melting and fusion of the bimetallic solder ball 54. Once the composition attains the melting point, the particles are interconnected by a thin eutectic temperature liquid film. (Underline added.)

Avery, col. 8, line 61 to col. 9, line 2. Accordingly, Avery fails to teach or suggest bonding with a metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding.

Jung fails to provide the missing teachings. In particular, Jung fails to teach or suggest bonding comprising plating metal on two positioned components. As discussed with respect to Figure 1 of Jung:

A product having a printed circuit board 100 (PCB) and at least one electronic component may be manufactured by a process including dispensing ... a slurry solder paste mixture 104 on at least a surface are 103 of PCB 100. ... Next is placing electronic component 101 over solder paste mixture 104.... (Underline added.)

Jung, col. 2, line 65 to col. 3, line 17. Accordingly, Jung fails to teach or suggest plating. Jung also fails to teach or suggest plating metal on two positioned components.

None of the cited references taken alone or in combination, teaches or suggests plating metal on two positioned components. The Applicants thus submit that Claim 1 is patentable over the cited art. The Applicants further submit that dependent Claims 2-4, 30-32, and 70 are patentable at least as per the patentability of Claim 1 from which they depend.

### **Claim 7 Is Patentable Over Ecer, Avery, And Jung**

Claim 7 has been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over Ecer in view of Avery and further in view of Jung. The Applicants respectfully submit that Claim 7 is patentable over the combination of Ecer, Avery, and Jung for at least the reasons discussed below.

Claim 7 has been rewritten in independent form without unnecessary recitations. As amended, Claim 7 recites a method of bonding two components including:

positioning the two components relative to one another to obtain a desired orientation; and

bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding;

wherein bonding comprises providing particles of the metal on the two components and bonding the metal particles;

wherein each of the particles of the metal comprises a dielectric material coated with the metal before bonding the two components.

Ecer discusses "joining processes for aerospace and automotive components" (Ecer, col. 1, lines 33-34), and more particularly, a "rocket component" (Ecer, col. 4, lines 63). Moreover, Ecer discusses typical bonding pressures that "range between 70 Mpa and 700 MPa" (Ecer, col. 4, lines 53-54), and these bonding pressures are incompatible with methods of Avery for "automated soldering of complex electronic components, such as chips to printed circuit boards, to other chips, or to other substrates" (Avery, col. 1, lines 14-16) and/or with methods of Jung of "making a metallic contact for soldering the electronic components on the printed circuit board" (col. 1, lines 9-10). Accordingly, it would not be obvious to somehow combine elements of Avery and/or Jung with Ecer to teach or suggest the recitations of Claim 7.

Moreover, Avery and Jung both teach away from a dielectric material coated with a metal. In contrast, Avery discusses "bimetallic particles" (Avery, col. 4, line 16), and Jung discusses "metallic particles coated with at least a metallic element" (Jung, col. 2, lines 23-25). Avery and Jung thus teach away from the combination suggested by the Office Action. The Applicants thus submit that Claim 7 is patentable over the cited art. In addition, dependent Claims 73 and 74 are patentable at least as per the patentability of Claim 7 from which they depend.

#### **Claim 20 Is Patentable Over Ecer And Avery**

Claim 20 has been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over Ecer in view of Avery. Claim 20, however, is patentable for at least the reasons discussed below.

Claim 20 recites a method of bonding two components, the method including:

- positioning the two components relative to one another to obtain a desired orientation; and

- bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding;

- wherein bonding comprises providing particles of the metal on the two components and bonding the metal particles; and

- wherein providing the metal particles comprises providing the metal particles in a foam and wherein bonding the metal particles comprises collapsing the foam.

The Office Action concedes that Ecer does not specifically disclose the step of providing particles in a foam. In support of the rejection, the Office Action states that:

However Avery et al. teaches forming a joint between components by providing the metal particle in a foam for the purpose of forming a thin and strong joints (Avery et al. column 12 lines 7-22, and figure 1).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the method of Ecer by providing the particles in a foam in view the teachings of Avery et al. since this technique is particularly useful in forming thin and strong joints (Avery et al. column 12 lines 7-22, and figure 1).

The cited portions of Avery discuss:

Porous joints or metal foams in which composition and pore size are chosen for any material system which exhibits a melting point minimum such as a eutectic. ... The liquid so formed causes the various particles to fuse together into a "metallic foam".

Avery, col. 12, lines 8-18.

Avery, however, fails to teach or suggest collapsing a metallic foam. Accordingly, neither Ecer nor Avery, taken alone or in combination, teaches or suggests providing metal particles in a foam and collapsing the foam.

In addition, there is no motivation to somehow combine elements of Ecer and Avery to teach or suggest the recitations of Claim 20. As discussed above, Avery discusses forming a metallic foam providing a porous joint. As further discussed in Avery:

Because the porous joint does not develop large triaxial stress components, its fatigue life is longer than a non-porous joint in a strain controlled environment. (Underline added.)

Avery, col. 11, lines 45-47. In contrast, Ecer discusses a substantially solid layer without voids. More particularly, Ecer states that:

Powder particles 22 are now flattened and particles have sheared and filled in substantially all voids 28. The initial weakly held-together layer of interface powder layer is now thinner and forms a substantially solid layer 26 without voids. ... As a result, particles 22 go through cold-work hardening and may become as hard as metals 10 and 11. (Underline added.)

Ecer, col. 5, line 66 to col. 6, line 3. Accordingly, Ecer teaches away from incorporation of the porous metallic foam joint of Avery, and Avery teaches away from incorporation of the solid layer of Ecer.

The Applicants thus submit that the combination of Ecer and Avery fails to teach or suggest the recitations of Claim 20 and that Claim 20 is thus patentable. In addition, dependent Claims 83 and 84 are patentable at least as per the patentability of Claim 20 from which they depend.

**Claim 21 Is Patentable Over Ecer And Avery**

Claim 21 has been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over Ecer in view of U.S. Patent No. 3,923,231 to Catalano et al. (hereinafter "Catalano"). Claim 20, however, is patentable for at least the reasons discussed below. Claim 20 recites a method of bonding two components, the method including:

- positioning the two components relative to one another to obtain a desired orientation; and

- bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding;

- wherein bonding comprises providing particles of the metal on the two components and bonding the metal particles; and

- wherein bonding the metal particles comprises introducing a liquid species that amalgamates with the particles at a bonding temperature less than the melting temperature of the metal.

The Office Action concedes that Ecer does not specifically teach providing liquid species that amalgamates with the particles at a bonding temperature less than the melting temperature of the metal, wherein the liquid species is mercury. The Applicants respectfully submit that it would not be obvious to selectively combine aspects of Ecer and Catalano to somehow teach or suggest the recitations of Claim 21.

In particular, Ecer discusses joining together metals and metal alloys including "copper, iron, nickel, cobalt, and their alloys." Ecer, col. 6, lines 22-23. In contrast, Catalano discusses "Diffusion Bonding Of Gold To Gold". Catalano, title. The Applicants respectfully submit that it would not be obvious to selectively substitute an interlayer material of Catalano used for gold to gold bonding in the bonding method of Ecer for copper, iron, nickel, cobalt, and their alloys.

Accordingly, the combination of Ecer and Catalano fails to teach or suggest the recitations of Claim 21, and Claim 21 is thus patentable. In addition, dependent Claims 22, 85, and 86 are patentable at least per the patentability of Claim 21 from which they depend.

**Claim 23 Is Patentable Over Ecer And Kuwabara**

Claim 23 has been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over Ecer in view of U.S. Patent No. 5,967,402 to Kuwabara (hereinafter "Kuwabara"). Claim 23 is patentable over Ecer and Kuwabara for at least the reasons discussed below. In particular, Claim 23 recites a method of bonding two components, the method including:

- positioning the two components relative to one another to obtain a desired orientation; and
- bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding;
- wherein bonding comprises providing particles of the metal on the two components and bonding the metal particles; and
- wherein bonding the metal particles comprises corroding the metal particles.

The Office Action concedes that Ecer does not teach bonding the metal particles by corroding the metal particles. The Applicants respectfully submit that Kuwabara fails to provide the missing teachings. In support of the rejection, the Office Action cites the abstract of Kuwabara and column 4, lines 4-40 of Kuwabara stating that Kuwabara teaches "bonding comprises corroding the metal particles by oxidation and galvanic reaction...." Office Action, page 9. Accepting for the sake of argument that Kuwabara does teach corroding metal particles by oxidation and galvanic reaction, Ecer teaches away from the incorporation of such reactions in the process thereof. In particular, Ecer states that:

The process preferably should take place in a reducing atmosphere or in partial vacuum or in a non-oxidizing atmosphere in which the most dominant alloying elements would be prevented from forming oxides. (Underline added.)

Ecer, col. 4, lines 39-42. Accordingly, even if Kuwabara does teach corroding metal particles by oxidation and galvanic reaction, it would not be obvious to use such corrosion in Ecer because Ecer teaches away from such a combination.

The Applicants thus submit that Claim 23 is patentable over the combination of Ecer and Kuwabara. In addition, dependent Claims 24, 25, 87, and 88 are patentable at least as per the patentability of Claim 23 from which they depend.

**Claim 27 Is Patentable Over Ecer and Avery**

Claim 27 has been rejected under 35 U.S.C. Sec. 103(a) as being unpatentable over Ecer in view of Avery. Claim 27, however, is patentable for at least the reasons discussed below. Claim 27 recites a method of bonding two components, the method including:

- positioning the components relative to one another to obtain a desired orientation;
- and
- bonding the two components in the desired orientation with metal wherein a temperature of both components is maintained below a melting temperature of the metal while bonding;
- wherein bonding comprises providing particles of the metal on the two components and bonding the metal particles; and
- wherein bonding the metal particles comprises plating a metal on the metal particles after providing the metal particles on the two components.

The combination of Ecer and Avery fails to teach or suggest plating a metal on metal particles after providing the metal particles on two components. As discussed above, Ecer does not discuss plating, and Avery discusses plating used to form coated bimetallic particles (see Avery, col. 4, lines 29-31). Neither of these references, taken alone or in combination, however, teaches or suggests plating a metal on metal particles after providing the metal particles on two components being bonded.

Accordingly, the Applicants respectfully submit that the combination of Ecer and Avery fails to teach or suggest the recitations of Claim 27, and that Claim 27 is thus patentable. In addition, dependent Claims 89 and 90 are patentable at least as per the patentability of Claim 20 from which they depend.

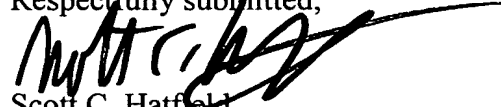
**CONCLUSION**

Accordingly, the Applicants submit that all pending claims in the present application are in condition for allowance, and a Notice of Allowance is respectfully requested in due course.

In re Glenn A. Rinne, *et al.*  
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The Examiner is encouraged to contact the undersigned attorney by telephone should any additional issues need to be addressed.

Respectfully submitted,



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